IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Didier BEUDON and Pierre BRIDENNE

Serial No:

Filed:

For: A DEVICE FOR DIFFUSING STERILE AIR IN A FABRIC SHEATH

DECLARATION

I, Andrew Scott Marland, of 35, avenue Chevreul, 92270 BOIS COLOMBES, France, declare that I am well acquainted with the English and French languages and that the attached translation of the French language PCT international application, Serial No. **PCT/FR99/03164** is a true and faithful translation of that document.

All statements made herein are to my own knowledge true, and all statements made on information and belief are believed to be true; and further, these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any document or any registration resulting therefrom.

Date: June 5, 2001

Andrew Scott Marland

09/868315
JC03 Rec'd PCT/PTC 18 JUN 2001

A DEVICE FOR DIFFUSING STERILE AIR IN A FABRIC SHEATH

The present invention relates in general to close protection for a workstation or a conveyor situated in a contaminated atmosphere, and more particularly to close protection apparatus for products that are sensitive to being contaminated by airborne contaminating agents, said products being positioned on a work surface or on a conveyor.

More particularly, the invention relates to a sheath of flexible material for close protection of products placed on a work surface and sensitive to airborne contamination, the protection being provided by diffusing a stream of sterile air, in particular in a direction that is substantially perpendicular to said work surface, said sheath defining a sterile air feed duct and presenting a geometrical singularity.

In conventional manner, a sheath of this type is made by a leakproof wall and a porous wall of perforated flexible material, such as a textile fabric, extending longitudinally along the axis of the sheath.

The term "singularity" is used herein to mean a bend, a branch connection, or a change of section in the sheath, for example.

In a sheath of the above-mentioned type, immediately downstream from a singularity in the sterile air flow direction in the sterile air feed duct defined by the sheath, it can happen that the speed profile of the sterile air stream is found to be deformed.

Thus, sterile air speeds in the flowing stream become locally too great, thereby generating dynamic air pressure at this location in the sheath, which is greater than the total pressure in said sheath. As a result, the static pressure of the air at this location in the sheath becomes negative and acts as suction on the inside face of the porous wall of flexible material of said sheath.

If the flexible material constituting the porous wall of the protective sheath is not very porous, then

the zone of suction created in this way inside the sheath immediately after the singularity can cause external air to be sucked into the sheath, thereby contaminating the sterile air diffused by said sheath.

If the flexible material constituting the porous wall of the protective sheath is very porous, then it is sucked towards the inside of the sheath at the location where the suction zone is created in this way and a phenomenon of fluttering or flapping is observed in the porous wall of the sheath at this location. This phenomenon then disturbs the speed profile of the sterile air leaving the sheath and it is no longer ensured that the flow of protective sterile air is uniform.

In order to mitigate the above-mentioned drawbacks, the present invention proposes a novel sheath of flexible material for providing protection by diffusing sterile air, the sheath being of the type defined above in the introduction and including an internal arrangement enabling the speed profile of the sterile air at the outlet from a singularity of said sheath to be recentered in such a manner as to maintain the static pressure at said location at a level which is high enough to prevent a suction zone being created.

More particularly, according to the invention, a sterile air diffusion cone is provided in said feed duct immediately after said singularity in the direction of sterile air flow in said duct, the diffusion cone being oriented in the sterile air flow direction and being centered on the longitudinal axis X of the sheath.

According to other, non-limiting and advantageous characteristics of the sheath of the invention:

· said diffusion cone is truncated;

· said diffusion cone has an angle at the apex lying in the range 30° to 45°, and preferably equal to about 45°;

· said diffusion cone is made of a perforated flexible material, preferably a textile material.

Preferably, said diffusion cone is made of a synthetic fabric such as a polyester or polypropylene fabric;

· said diffusion cone is made of a perforated rigid material;

· the material constituting the diffusion cone has porosity of about 0.5;

· said diffusion cone is secured to the end of a sleeve positioned inside said sterile air feed duct on the longitudinal axis of the sheath and presenting a section that is slightly smaller than that of the sheath;

· said sleeve is made of a material that is less porous than the material of said diffusion cone;

· said sleeve is made of a perforated flexible material such as a textile material such that under the action of the sterile air passing through, it takes up an oval shape and comes into contact with the inside face of a wall of the sheath; and

· the sheath includes a central branch connection constituted by a sterile air feed duct opening out into said sheath in a direction Y that is substantially perpendicular to the longitudinal axis X of the sheath such that at the outlet from said sterile air feed duct the sterile air flows in two opposite directions generally along the longitudinal axis X of said sheath, the sheath being provided internally at the outlet from the branch connection with a diffusing sleeve extending along the longitudinal axis X of the sheath and having a diffusion cone at each end, the cones being oriented in the sterile air flow direction and centered on the longitudinal axis of the sheath.

The invention also provides a sheath of flexible material for close protection of products placed on a work surface and sensitive to airborne contamination, the protection being provided by a stream of sterile air, in particular in a direction that is substantially perpendicular to said work surface, said sheath defining a sterile air feed duct and presenting a geometrical

singularity, and a sterile air diffusion hemisphere is provided in said feed duct immediately after said singularity in the direction of sterile air flow in said duct, the hemisphere being oriented in the sterile air flow direction and being centered on the longitudinal axis X of the sheath.

The following description with reference to the accompanying drawings given as non-limiting examples explain what the invention consists in and how it can be implemented.

In the accompanying drawing:

· Figure 1 is a diagrammatic perspective view of an embodiment of a protective sheath of the invention;

· Figure 2 is a section view on plane A-A of Figure 1; and

· Figure 3 is a section view on plane B-B of Figure 1.

In Figures 1 to 3, a sheath 10 of flexible material is shown for close protection of products placed on a conveyor or a work surface (not shown) and that are sensitive to airborne contamination, with protection being provided by diffusing sterile air, in particular in a direction that is substantially perpendicular to said conveyor.

The sheath 10 is not described in detail herein, and for a detailed description of a preferred embodiment of such a sheath reference is made to document WO 97/40325 belonging to the Applicant.

More particularly, as shown in the figures, the sheath 10 is in the form of a circular cylinder about a longitudinal axis X, and it has a top wall 11 made of a textile material of low porosity or of a plastics film, forming the top half-perimeter of the sheath 10, and a porous bottom wall 12 forming the bottom half-perimeter of the sheath 10. Said walls 11, 12 extend longitudinally along the longitudinal axis X of the sheath 10.

The wall 11 constituting the top half-sheath and the porous wall 12 constituting the bottom half-sheath define between them a sterile air feed duct 13 that is of tubular shape extending along the longitudinal axis X.

The fabric used for making the top half-sheath 11 of the sheath 10 is constituted, for example, by a polyester fiber fabric presenting porosity with a mesh having openings of 5 micrometers (μm) to 10 μm.

The fabric used for the porous bottom half-sheath 12 is constituted, for example, a polyester fiber fabric presenting porosity with a mesh having openings of 15 μm to 30 μm.

The sheath 10 extends longitudinally parallel to the longitudinal edge of the conveyor or the work surface (not shown) over the entire length thereof.

Advantageously, each outer longitudinally-extending edge of the top half-sheath 11 of the sheath 10 situated over a longitudinally-extending edge of the conveyor can be extended tangentially by a skirt (not shown herein).

The two skirts situated at respective edges of the top half-sheath hang substantially perpendicularly to the work surface or the conveyor and are either equal in length, or else of different lengths lying in the range 50% to 100% of the height that exists between the conveyor or the work surface and the middle axis of the sheath.

This arrangement makes it possible to ensure that sterile air is diffused at slow speed all along the middle of the porous wall 12, while sterile air is diffused at higher speed on either side thereof.

In a variant of the sheath 10 (not shown), provision can be made for it to have a low porosity wall occupying 75% of the perimeter of the sheath, with a porous wall occupying 25% of the perimeter of the sheath.

The low porosity wall forms the top portion of the sheath and the porous wall forms the bottom portion of the sheath.

The porous wall feeds a longitudinally-extending diffusion pocket situated beneath it, with the outer wall of the pocket having two lateral strips secured to the longitudinally-extending edges of the leakproof wall and a porous middle zone between two lateral slots adjacent to said leakproof lateral strips.

This arrangement also makes it possible to diffuse the sterile air slowly via the middle zone of the longitudinal diffusion pocket, with said slow diffusion being between two faster jets.

In addition, as shown more particularly in Figures 1 to 3, the sheath 10 in this case includes a singularity. This singularity, in the embodiment shown, is constituted by a central branch connection which consists in a sterile air feed duct 20 extending along an axis Y perpendicular to the longitudinal axis X of the sheath and opening out into said sheath along said perpendicular direction.

At the outlet from this sterile air feed duct 20, the sterile air flows in a vertical direction f and then flows into the sheath 10 in two opposite directions extending generally along the longitudinal axis X of said sheath 10.

Naturally, in other embodiments (not shown), the singularity could be different, a bend or a narrowing or an enlargement in the section of the sheath, for example.

The sterile air feed duct 20 is mounted in leakproof manner in the leakproof top wall 11 of the sterile sheath.

To this end, the top wall 11 of the sheath 10 has a raised portion 14 extending along the axis Y of said sterile air feed duct 20 and presenting an opening at its end into which the feed duct 20 is fitted, for example.

Sealing can be provided at the connection by means of a sealing gasket 15, for example.

The sterile air feed duct 20 extending along the axis Y opens out into the sterile air feed duct 13

defined by the sheath through the inside face of the leakproof top wall 11 of said sheath 10.

In addition, inside the sterile air feed duct 13 defined by the sheath 10 immediately downstream from the singularity in the direction of sterile air flow in said sheath 13, provision is made for a diffusion cone 30 to diffuse the sterile air, said cone extending in the sterile air flow direction and being centered on the longitudinal axis X of the sheath 10.

In the example shown, two diffusion cones 30 facing in the two opposite directions of sterile air flow leaving the sterile air feed duct 20 are provided in this case at the outlet from the central branch connection, said cones being centered on the longitudinal axis X of the sheath 10.

Each of the diffusion cones 30 presents an angle α at its apex lying in the range about 30° to about 45°, and preferably equal to 45°.

Each diffusion cone 30 can be made of a perforated flexible material, preferably a textile material such as a synthetic polyester or polypropylene fabric.

Each diffusion cone can also be made of a perforated rigid material.

The material constituting each diffusion cone 30 can have porosity equivalent to that of the porous wall 12 of the sheath 10, e.g. equal to about 0.5.

The diffusion cones serve advantageously to distribute sterile air uniformly inside the sheath 10 at the outlet from the singularity so as to avoid any local increase in air speed that would lead to a drop in static pressure over the inside face of the bottom porous wall of the sheath 10 which could then lead either to outside air penetrating into the sheath or to said bottom porous wall of the sheath fluttering or flapping.

In addition, as shown in the figures, each diffusion cone 30 is secured to a respective end 41, 42 of a sleeve 40 placed inside the sterile air feed duct 13 defined by

the sheath 10, along the longitudinal axis X of the sheath 10, and presenting a section that is slightly smaller than that of the sheath 10.

In this case, the sleeve and the two cones form a single part.

Naturally, provision can be made for the sleeve and the two cones to form three parts that are assembled together.

The sleeve 40 can be made of a material that is less porous than that of the diffusion cones 30. It can be made of a perforated flexible material such as a textile material or a perforated rigid material such as a perforated metal sheet.

Its diameter is advantageously about 10% smaller than the diameter of the sheath 10.

When it is made of a perforated flexible material, such as a textile material, a polyester or polypropylene fabric, then the sterile air passing through it causes it to take up an oval shape bringing it into contact with the inside faces of the top and bottom walls of the sheath 10.

The assembly constituted by the sleeve 40 and the two diffusion cones 30 is secured to the sheath 10 by means of a raised portion 43 of said sleeve extending along the axis Y and mounted in leakproof manner at the outer end of the raised portion 14 of the leakproof wall 11 of the sheath 10.

In the example shown, the diameter d_1 of the sterile air feed duct 20 forming the central branch connection is about 100 millimeters (mm), the sleeve 40 is about 130 mm long, and each diffusion cone 30 is 120 mm long, the sheath 10 having a diameter of 120 mm.

Naturally, the present invention is not limited in any way to the embodiment described and shown, and the person skilled in the art can make any variant thereto within the spirit of the invention.

In particular, in other embodiments, the singularity of the diffusion sheath of flexible material can be a bend.

Under such circumstances, a single diffusion cone is provided inside the sheath at the outlet from the bend and centered on the longitudinal axis of the sheath, the cone being secured to one end of a diffusing sleeve whose opposite end is closed.

It is also possible to provide for the singularity in the sheath to be a change in the section of the diffusion sheath, e.g. a narrowing or an enlargement.

Under such circumstances, at the outlet from the change in section, a single diffusion cone should be provided inside the sheath facing in the sterile air flow direction and centered on the axis of the sheath.

In the invention, it is also possible to juxtapose a plurality of sheaths over a wide work surface or conveyor so that the sheaths extend parallel to the direction of the longitudinal edges of the work surface or conveyor.

Each sheath including a singularity should be fitted as described above with a sterile air diffusion cone positioned inside the sterile air feed duct defined by the sheath.